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MINOR STUDIES FROM THE PSYCHOLOGICAL LAB-
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COMPARATIVE OBSERVATIONS ON THE INVOLUNTARY
MOVEMENTS OF ADULTS AND CHILDREN.

BY MILO ASEM TUCKER.

There is but little available literature upon involuntary movements. Stricker, Lehmann, Féré and Jastrow give some facts bearing either directly or indirectly upon the subject.

Stricker's observations, in general, are too well known to need citing here. He calls attention to the influence of the representation of moving objects. By remaining quiet and imagining that he moved, he experienced a sensation in those muscles involved in the actual movement.¹

A further statement of Stricker's is that his remembrance of motion of inanimate objects is mostly associated with feelings in the muscles of the eyes.²

After describing many experiments, Stricker says that he cannot picture to himself any motion without calling into play, by that means, through the centrifugal impulse, the actual muscular feeling.³

Lehmann says: "The execution of a certain motion requires a comparatively strong concentration of attention on the idea of the motion and suggested motions take place only in the deeper stages of hypnosis."⁴ He then draws a distinction between concentration of attention on the perception of motion and kinesthetic ideas. He says, "So long as I perceive and desire to perceive sharply, my attention is directed to the sensory apparatus. . . . If, on the other hand,

¹ Stricker, "*Bewegungsvorstellungen*," p. 12 ff.

² *Ibid.*, p. 17.

³ *Ibid.*, p. 27.

⁴ Lehmann, "*Die Hypnose*," p. 166.

I desire to execute a motion, then my attention must be turned from the sensory apparatus to that part of the sensorium where ideas of motion arise.¹

Féré, on the other hand, experimented with a dynamometer. He says that the mass of his observations indicates that each time the cerebral centre enters into action, it starts the excitation of the whole organism, by a process still undetermined; and when we say the brain thinks, it is the whole body which enters into activity.²

Jastrow, using his automatograph,³ found the following results: First, a general tendency for the hands involuntarily to follow, sympathetically, the movements of the eyes in glancing along rows of colors or points.⁴ Second, a movement of the hands toward stationary objects to which the attention was directed.⁵ Third, the movements toward the front and toward the body were more favored than toward the rear and away from the body.⁶ Fourth, a tendency for the hands to move sympathetically with rhythmic motions.⁷ Fifth, a variation in results with the individuals and the sense organ engaged.⁸

The apparatus with which the present investigations were made, is practically Jastrow's automatograph, with a slate substituted for the upper glass plate. The balls on which the upper plate rested were balls used for bicycle bearings.

The number of reagents tried by Jastrow and the proportion of cases which he called "typical" are not stated in his investigation. A more serious criticism is that any spontaneous tendency the hand might have to move in a given direction, was not previously determined. Before one can predicate anything in regard to the influence of representations of motion, it is first necessary to ascertain whether the muscles have a tendency toward motion in any given direction. For the purpose of determining and estimating this last point as well as for marking the general tendencies of motion, what may be called the field of movements, for the hands may be considered as a circle. The horizontal and vertical diameters were used as dividing lines. The semi-circles above and below the horizontal diameter may be designated the positive and negative field respectively, and the

¹ *Ibid.*, p. 170.

² Féré, "*Sensation et Mouvement*," p. 25.

³ Jastrow, *AMERICAN JOURNAL OF PSYCHOLOGY*, IV, p. 398 ff; V, 223 ff.

⁴ *Ibid.*, IV, pp. 400-1.

⁵ *Ibid.*, IV, pp. 400, 404.

⁶ *Ibid.*, p. 407; V, p. 427.

⁷ *Ibid.*, IV, pp. 402-3.

⁸ *Ibid.*, p. 405, V, p. 230.

semi-circles to the right and left of the vertical diameter, the right and left field respectively. A record of angular degrees of movements was also kept.

Practically, like directions were given to all reagents. A seat was taken at the table upon which the apparatus was placed. The finger-tips of the extended hand were placed lightly upon the upper surface, at a convenient distance from the body, that is, at a distance where the reagent was not conscious of any muscular strain. The arm was not per-

TABLE I.

ATTENTION DIRECTED TO SOME STATIONARY OBJECT.

Number of reagents: Adults, 18; children, 13. Number of cases: Adults, 367; children, 164.

Position of Object.	Hands Used.	ADULTS.				CHILDREN.			
		Positive Field.	Negative Field.	Left Field.	Right Field.	Positive Field.	Negative Field.	Left Field.	Right Field.
Front	Both	35	19	18	36	11	14	12	13
	Right	26	28	39	15	10	11	13	8
	Left	24	26	12	38	4	20	7	17
Totals		85	73	69	89	25	45	32	38
Left	Both	20	14	16	18	5	11	11	5
	Right	19	17	21	15	2	14	10	6
	Left	16	17	18	15	4	12	7	9
Totals		55	48	55	48	11	37	28	20
Right	Both	15	18	10	23	5	10	5	10
	Right	15	21	18	18	1	14	11	4
	Left	19	18	10	27	2	14	2	14
Totals		49	57	38	68	8	38	18	28

mitted to touch at any point, but to remain in a comfortable, forward position. No attention was to be given to the hand, apparatus or other objects about the room, except to such as were especially named as objects of attention. The reagents were always ignorant of the purpose of the experimentation. Each reagent was questioned afterwards regarding the work. The movements were generally unconscious, and only those that could fairly be called involuntary were counted.

TABLE II.

CONSTANTS: ATTENTION NOT DIRECTED TO ANY EXTERNAL OBJECT.

Number of reagents: Adults, 18; children, 25. Number of cases: Adults, 314; children, 209.

Position of Hands.*	Hands Used.	ADULTS.				CHILDREN.			
		Positive Field.	Negative Field.	Left Field.	Right Field.	Positive Field.	Negative Field.	Left Field.	Right Field.
I	Both	21	10	14	17	8	14	16	6
	Right	23	15	25	13	4	19	18	5
	Left	17	22	12	27	7	18	12	13
Totals		61	47	51	57	19	51	46	24
II	Both	21	10	19	12	7	15	14	8
	Right	20	17	25	12	8	14	18	4
	Left	17	18	13	22	4	21	8	17
Totals		58	45	57	46	19	50	40	29
III	Both	15	14	15	14	8	15	15	8
	Right	20	19	19	20	8	17	16	9
	Left	15	20	11	24	4	18	7	15
Totals		50	53	45	58	20	50	38	32

*Arms forward; I, near body; II, moderately extended; III, full length.

In determining the physiological tendencies of the hands toward motion in any direction, the thoughts of the reagents were necessarily turned towards things that had no connection with ideas of motion of the hands or body. Accordingly, in getting at these "*constants*," as we may term them, the reagent conjugated French verbs, recited the multiplication table, hummed songs, or in the case of children, counted aloud. During this time the hands were held in the three positions indicated in Table I, to see what the difference would be, if any, in the results.

From Table I, it may be estimated that for adults there were 51.5% of the movements in the positive or forward field, while 48.5% were in the negative field. For children, the entire movements in the positive field were only 26.9%, while those in the negative field were 73.1%.

From Table II, representing constants, that is, spontaneous movements of the hands, we see that the total movements for adults in the positive field were 53.8%, while those in the negative were 46.2%. For children the corresponding movements were 27.8% and 72.2% respectively. The similarity in the movements between the times when the attention was directed and when it was what may be called distracted, is very striking. See Tables I and II, also Figure 1 of the Plates at the end of the article.

TABLE III.

TABLES I AND II COMBINED AND CONDENSED.

Number of reagents: Adults, 36; children, 38. Number of cases: Adults, 681; children, 373.

Hands Used.	ADULTS.				CHILDREN.			
	Positive Field.	Negative Field.	Left Field.	Right Field.	Positive Field.	Negative Field.	Left Field.	Right Field.
Both	127	85	92	120	44	79	73	50
Right	123	117	147	93	33	89	86	36
Left	108	121	76	153	25	103	43	85
Totals	358	323	315	366	102	271	202	171

In Table III, the results of the preceding series have been combined and condensed. The movements, though more in

number, remain practically the same. For adults, the movements in the positive field are 52.5%, and in the negative field 47.5%, while for children in the same respective fields the movements are 27.3% and 72.7%.

On examining these tables, one is impressed with the similarity of the movements in the right and left fields. Nearly the same results are to be seen in Tables I, II and III, but in Table IV the comparisons are more plainly shown. It is to be seen that when both hands are placed together the percents of movements are not far apart. An interesting fact is to be observed in the move-

TABLE IV.

COMPARISON OF MOVEMENTS IN THE LEFT AND RIGHT FIELDS.

Total number of reagents—74. Total number of cases—1,054.

HANDS USED.	ADULTS.				CHILDREN.				ADULTS AND CHILDREN.			
	Left Field.		Right Field.		Left Field.		Right Field.		Left Field.		Right Field.	
	No. Cases.	Per cent.	No. Cases.	Per cent.	No. Cases.	Per cent.	No. Cases.	Per cent.	No. Cases.	Per cent.	No. Cases.	Per cent.
Both	92	43	120	57	73	59	50	41	165	49	170	51
Right	147	61	93	39	86	70	36	30	233	64	129	36
Left	76	33	153	67	43	33	85	67	119	34	238	66

ments of the right and left hands. For adults and children, taken separately, the results are very nearly alike. For both together, the right hand moves in the left field 64% versus 36% in the right, while the left hand moves in the right field 66% versus 34% in the left. This means, of course, that normally both the hands and the arms move inwardly toward the median plane of the body.

These results are, therefore, contrary to those of Jastrow, from the best that we can judge from his work, since no tables are given. As was previously stated, Jastrow failed to determine any spontaneous tendency of the hands to move in a given direction. The movements here were not toward the stationary object of attention, unless the object was upon the side toward which the muscles normally contracted.

On examining Table V, some interesting facts are to be seen. Adults are much more direct in their movements than children. Of the adult movements, 71% are fairly direct, and

TABLE V.

RELATIVE DIRECTNESS OF MOVEMENTS.

Number of reagents: Adults, 36; children, 38. Number of cases:
Adults, 668; children, 474.

HANDS USED.	ADULTS.				CHILDREN.			
	I*	II	III	IV	I	II	III	IV
Both	154	43	4	45	38	32	87	122
Right	164	74	4	58	37	28	92	127
Left	157	57	11	73	28	26	106	138
Totals	475	174	19	176	103	86	285	387
Totals in percent.	71	27	2	32	21	13	66	68

2% are very irregular, while 21% of children's movements are fairly direct, and 66% are very irregular. The changes of the original direction with adults are 32%, while with children they are 68%, as compared with adults.

An effort was made to see which hand, if either, influenced the motion more when both hands were placed together. The number of reagents for adults were 28, with 200 cases. Of the right-handed persons, 75 movements were to the left and 100 to the right. Of the left-handed persons, 10 movements were to the left and 15 to the right. With children, the number of reagents were 38, with 151 cases. The children were all right-handed. There were 85 movements to the left and 66 to the right.

The question now arises, can involuntary muscular movements of the hands and arms be influenced or controlled by visible motion? For testing this, inanimate moving objects were introduced. A small can or bottle was drawn along by a string, while the reagent watched it. The results are shown in Table VI, and also in Figures 2, 3, 4 and 5.

From the results in Table VI, it may be estimated that 87.9% of adult movements imitate the direction of the moving object, while 12.1% do not. Of the children 81% imitate, while 19% do not. If we consider the entire number of

* I,—Fairly direct; II,—Moderately direct; III,—Very irregular, and IV,—Original direction changed.

TABLE VI.

CONTROL OF INVOLUNTARY MUSCULAR MOVEMENTS BY THE INFLUENCE OF MOVING OBJECTS.

Number of reagents: Adults, 24; children, 24. Number of cases: Adults, 332; children, 170.

DIRECTION OF MOVING OBJECT.	HANDS USED.	ADULTS.		CHILDREN.	
		Following.	Not Following.	Following.	Not Following.
In front from side to side.	Right	100	14	65	16
	Left	88	16	61	16
To and from the body vertically and diagonally.	Right	30	3		
	Left	30	4		
Moving around a parallelogram or around the room in a circle: the number of re- agents was 8 adults, 4 children.	Both	5		4	
	Right	20	1	4	
	Left	19	2	4	
Totals		292	40	138	32

the movements of adults and children, amounting to 502 cases, we find 85.6% are in imitation of the direction of the moving object, while only 14.4% are not.

In Figure 6 one sees how marked the imitation is when the object viewed was passed around the room. Not all adults imitate so readily, and the results of the children are often very irregular, but the general direction is marked. In some cases the hand nearly flew around in imitation of a rapidly rotating object.

There is another marked phase of the investigation. The reagent, after seeing the moving object, was asked to close the eyes and think of the object moving. The number of reagents was 13, and the number of cases was 56. Of these 55, or 98.2%, were in the direction of the motion thought of, and only 1.8% failed to imitate the direction. See illustration in Figure 5.

In certain individuals, the idea thought was strong enough

to call the body into corresponding action. The reagent was asked to think of playing a chord upon the piano. At once the hand moved to the right in a fairly direct way. On thinking of playing downward, the hand slowly moved to the left. The same individual was asked to read columns and rows of figures in various directions. The hand moved in imitation of the direction of the thought, but to a less extent than before. See Figures 7 and 8. Often there was, with other reagents, a slight imitative movement, but frequently the result was a straight line. The person who gave the most marked results said the idea of direction was the "most important feature" in the reading of the numbers, though "the shape of the figures impressed themselves."

In the case of a person who was successful in working the "Ouija" board or planchette, the answers to different questions were written out. The reagent, on being questioned, said the words written were "whatever came into the mind, and that the hand involuntarily wrote the thing which happened to be thought of at the time." See Figure 9.

Another variation is thinking of hidden objects. The reagent was told to hide a knife or a bunch of keys in some part of the room. On returning, the hands were placed as in the other experiments, and the person was to think of the hidden objects. With 4 reagents and 13 cases, there were 8 movements in the direction of the hidden object and 5 which were not. The most "successful" reagent said: "I did not think *so much* of the *place* of hiding, but of the *direction* I took to hide them." It will be seen that these various facts bear out Lehmann's views.

The cumulative force of a series of kinæsthetic ideas was shown in the following trials. The repetition of the sight of moving objects increased the susceptibility of the person towards imitation. From 22 reagents, 12 adults and 10 children, the following results were obtained: In 13 cases the direction was imitated after 1 repetition; in 9 cases after 2 repetitions; in 1 case after 3, and in 1 after 6 repetitions. With 2 adults the direction was not followed, in 2 cases after 2 repetitions; and in 2 cases after 3 repetitions; and with 4 children, in 4 cases after 2 repetitions. This, in part, probably substantiates Féré's statement that increased attention increases the force of the movement,¹ and that the energy of the movement is in proportion to the intensity of the mental representation of the same movement.² The sight of motion invites the reproduction of the movement, and the motion

¹ "*Sensation et Mouvement*," p. 18.

² *Ibid.*, pp. 44-5.

In the following figures B = both hands, R = right hand, L = left hand. The arrow, which indicates the direction of the object, either stationary or moving, as well as the letters are placed at the point of beginning.

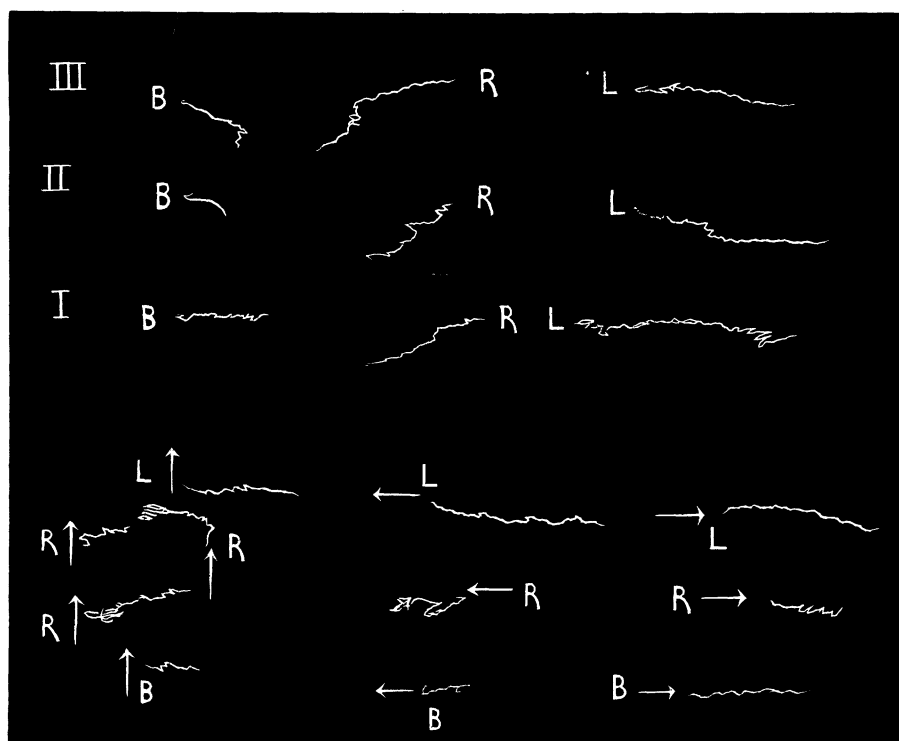


FIG. 1.

In the lower half, the reagent fixed the eyes and thoughts on a stationary object. In the upper half, the reagent closed the eyes and repeated the multiplication table. I = arms forward near body; II, moderately extended; III, full length.

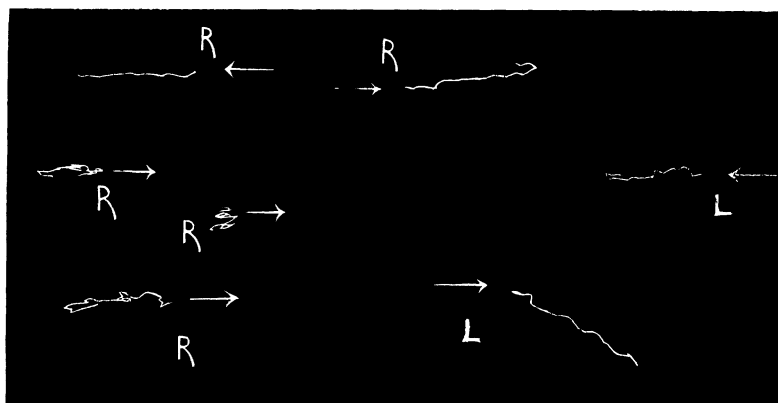


FIG. 2.

Reagent watching an object move in front. Failed to imitate the direction in the three trials in the lower left-hand side.

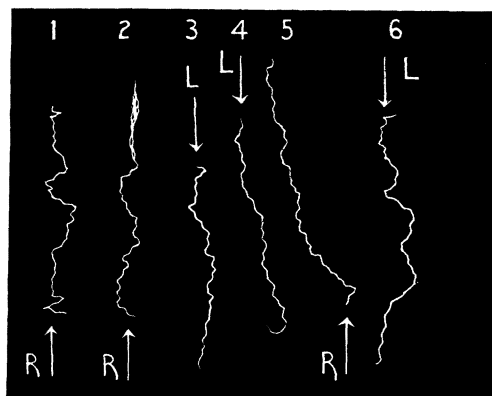


FIG. 3.

Reagent saw object moving in 1, 2, 3 and 4. In 5 and 6 the eyes closed and thought of object moving.

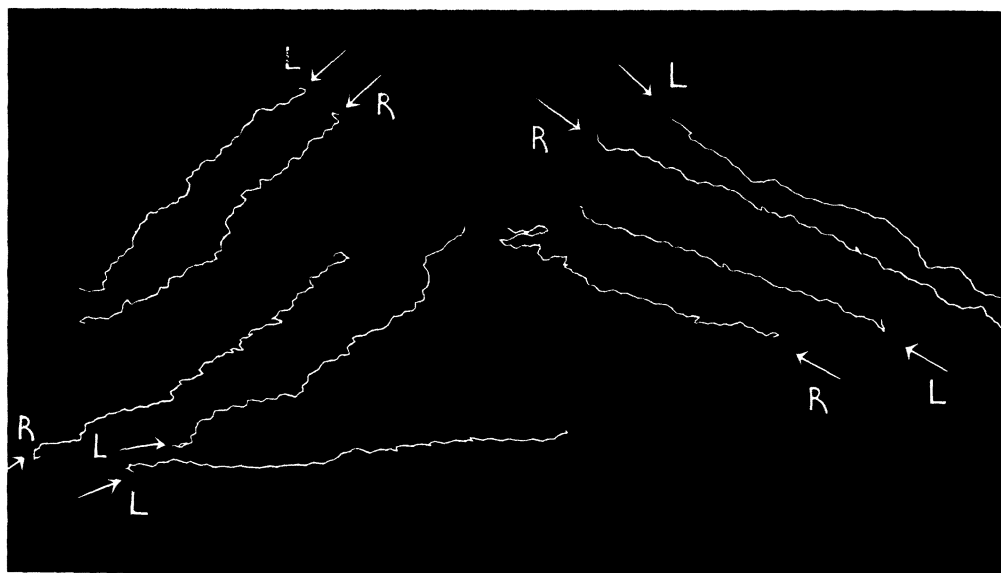


FIG. 4.

Reagent saw object moving at different times in various directions.

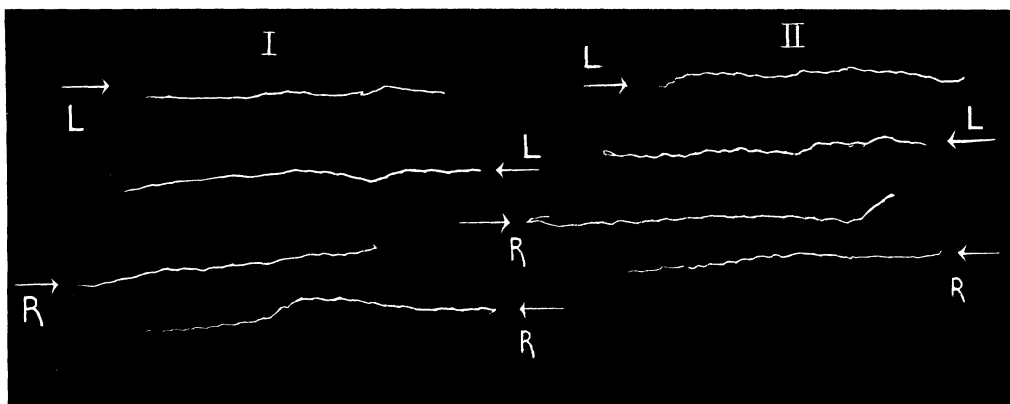


FIG. 5.

- I. Reagent saw object moving.
- II. Reagent closed eyes and thought of object moving.

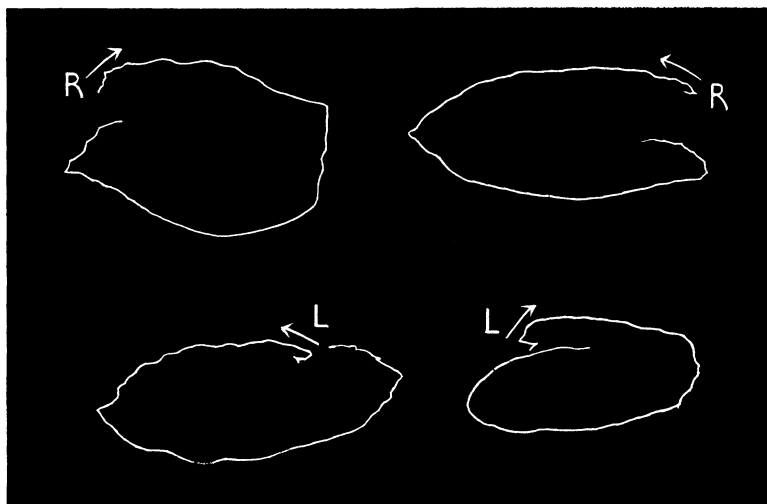


FIG. 6. (Half size.)

Reagent watching a person with an object move around the room in closed curves.

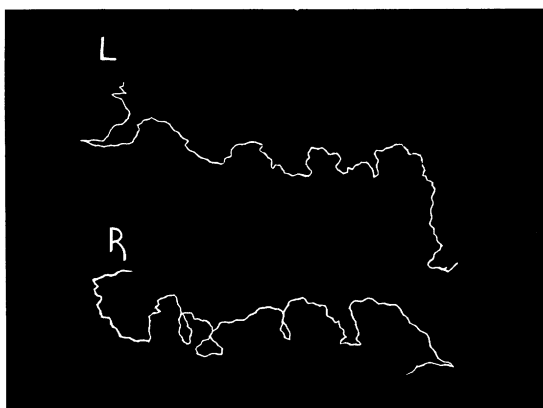


FIG. 7.

Reagent reading 11 columns of figures up and down.

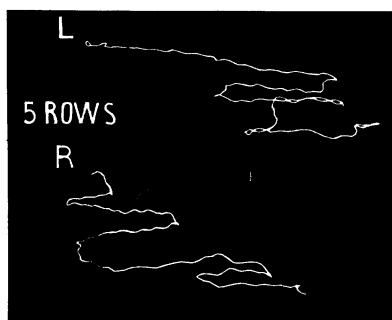


FIG. 8.

Reagent reading 5 rows of figures back and forth.

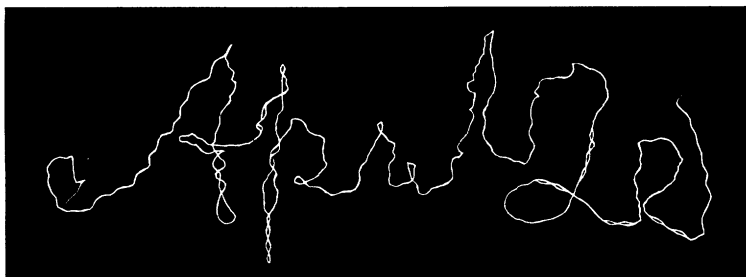


FIG. 9.

Reagent simply thought of the date, "April 20," and the hand wrote it in answer to a question requiring a date.

comes as an irresistible impulse or an inevitable consequence by the persistence of the idea.¹

With six reagents in thirteen cases, where disturbances occurred or the attention was drawn to something else, the hand-movements were abnormal or there was no movement at all. When the reagents were tired, worried or confused, irregular results followed. In fact the experimenter could always tell by the irregularity of the lines when the attention of the reagent was distracted.

Figure 2 illustrates how the idea of motion is taken up. In seven trials Miss E. had given irregular movements three times and had followed the moving object four times. Between the third and fourth trial the cabman called for her. After finishing, the experimenter told her that she had not held her attention on the moving object in the first three trials. Somewhat surprised, Miss E. said such was the case; that the arrival of the cab had aroused her attention, so that she fixed it on the moving object during the last four trials.

Our investigations would indicate that the whole body moves when we think, though, of course, almost imperceptibly. Reagents often turn the head or sway the body so one can see them move at the same time and in the same direction as the hands and arms move. Especially is this often marked when they think of moving objects with the eyes closed. With children the head often nods and the face scowls. The tendency of the amateur bicycle rider to be "fascinated" by an obstacle is an illustration of this tendency in movements.

This view disagrees with Stricker when he states that the remembrance of motion of inanimate objects is mostly associated with the sensations in the muscles of the eyes. Yet we must remember that Stricker only observed the feeling by muscular effort, and had no delicate means of marking it. The view disagrees with Jastrow when he states that the hands tend to move toward stationary objects to which the attention is directed. The experiments tend to substantiate the views of Féré and Lehmann, as previously given.

To sum up:

1. There is a physiological tendency for the hands and arms resting in front of the body to move inward toward the median plane of the body.
2. There is no certainty that when we see an object we tend to move toward it. We may think of it simply as an object at rest, and the idea of motion is necessary to cause movement in that direction.

¹ *Ibid.*, p. 45.

3. Involuntary muscular movements may be controlled by the influence of the sight or vivid visual remembrance of moving objects: and the imitation of the direction of moving stimuli is the result.

4. Children are governed by and subject to the same laws as adults, but to a less extent.

5. There is no sex or age difference in children, either in involuntary or controlled muscular movements.¹

¹ The writer is under many obligations to Dr. Frank Angell for valuable assistance and many suggestions, as well as to Mr. W. S. Libby; also to Mr. C. J. C. Bennett, and the many others who kindly and carefully assisted in the experimentation. For the opportunity of experimenting with the children, the writer is indebted to the courtesy of the teachers of Mayfield, California.